

A Report on the Missouri Agroforestry Program Established by
The Missouri Economic Diversification and Afforestation Act of 1990
as Amended in 2001

Submitted to
The Honorable Governor Matt Blunt
and
The General Assembly

by
Center for Agroforestry, University of Missouri
Missouri Department of Economic Development
Missouri Department of Conservation

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EXECUTIVE SUMMARY:

The Missouri Economic Diversification and Afforestation Act of 1990 (revised in 2001) directed the Missouri Department of Conservation (MDC) to develop and implement an agroforestry program. This legislation created a subsidy (safety net) program for landowners to apply agroforestry technology. The MDC contracted with the Center for Agroforestry at the University of Missouri (UMCA) for a research and technology transfer program - - funding was provided for partial support of a technology transfer and tree improvement specialist which continues today.

Accomplishments have been many and include:

- Establishing 12 contracts with landowners in support of their adopting agroforestry practices - - these contracts were for 10 years and have, or will soon, expire.
- Developing agroforestry and forestry technologies to increase Missouri forest land under management. Missouri's forest products industry contributed \$4.4 billion to the Missouri economy in 2005, while only 10-15% of our 14 million acres of forest land is managed. By developing uses for small diameter, low grade trees, this amount can easily be doubled or even tripled. The University's Center for Agroforestry, MDC and Missouri Forest Products Association (MFPA) are partnering to increase our forest land under management.
- Introducing commercially valuable tree species into pastures (silvopasture) has been demonstrated to be highly beneficial to pasture and cattle, improving the bottom line while creating valuable timber and nut trees.
- Gourmet and medicinal mushroom technology has been developed and is being adopted. Fresh shiitake mushrooms sell for between \$5 and \$16 per pound. Research is underway on commercial production of morels and European truffles.
- Missouri's black walnut nut industry ranges from \$15-\$25 million annually. UMCA's research on developing genetically superior cultivars will create new orchards adding \$20 million more per year to Missouri's economy.
- UMCA's research program on improved cultivars of pecan and enhanced yields from organic native pecan stands will result in a 3-to-4 fold increase in yields per acre by 2020.
- UMCA's research and technology transfer programs on Chinese chestnut will result in the planting of 1,000 acres in Missouri by 2020 creating a crop value of more than \$10 million.
- UMCA's research on having 300' to 500' tree buffers on the river-side of levees has demonstrated that river levees can be protected during major floods, with the potential to protect valuable Missouri farmland and homes, saving the state tens of millions of dollars.
- Windbreaks are being touted for odor abatement around CAFO's. EQIP dollars are now available for implementing the technology.
- Oak restoration on abandoned bottomland crop fields has been demonstrated along with its value for bird species and economic gain.
- UMCA's research on agroforestry-type buffers has demonstrated that narrow (13-foot wide) buffers using the appropriate species can effectively remove 75-80% of atrazine, metolachlor and glyphosate (Roundup) from runoff. Furthermore, microorganisms isolated from the root area of Eastern Gammagrass have been shown to have the capacity to reduce atrazine to harmless products within a 72-hour period.
- A highly effective Agroforestry Technology Transfer Program has been developed at the University of Missouri's Center for Agroforestry with funding assistance from the MDC. Accomplishments during 2005 are identified.

INTRODUCTION:

Missouri's small family farms must compete in a financial and policy environment that does not afford the same opportunities available to corporate farms in conventional agricultural markets. However, this segment of the farm population controls millions of acres of underutilized land that, if managed differently, could benefit the small family farm operator and Missouri's economy alike. In particular, agroforestry (defined as **"land-use management that optimizes the benefits from interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock"**) and conventional forestry have the potential to provide numerous environmental and conservation benefits while yielding reasonable short- and long-term financial gains to the small family farm operator. For the small family farm operator, agroforestry/forestry practices moderate microclimates reducing both wind erosion and direct damage to crops and protect livestock, thereby increasing crop yields and animal weight gain while providing additional farm income from trees and new crops (e.g., specialty crops). The benefits to society and Missouri as a whole include the reduction of erosion, enhancing nutrient absorption and cycling, intercepting waterborne chemical pollutants, sequestering CO₂, reducing flooding, enhancing wildlife, and helping our state meet its future domestic and export wood demands. Properly applied, agroforestry has the potential to meet the specific needs of Missouri landowners while preserving the integrity, stability and beauty of the small family farm. Rural Missouri and the small family farm are looking for a new vision, one that includes alternatives to "help pay the bills" and preserve the integrity of rural communities. Agroforestry creates a meaningful opportunity to help realize that vision. **Further, with fourteen million acres of largely unmanaged forest, a shortfall predicted for U.S. wood production and a national imperative to achieve energy independence from imported fossil fuels, increased use of sustainable agroforestry and forest management is worth billions of dollars to the people of Missouri and the nation.**

The University of Missouri Center for Agroforestry (UMCA) is one of the world's leading centers contributing to our understanding of the science underlying agroforestry and serves with the Missouri Department of Conservation (MDC) in directing agroforestry efforts in Missouri. Interdisciplinary collaboration is one of the most notable hallmarks of UMCA. To achieve its objectives, UMCA draws upon diverse knowledge, talent, and resident intellectual capacity and supports researchers located in academic departments across our College. This includes MU faculty in forestry, fisheries and wildlife, entomology, plant pathology, agronomy, animal science, horticulture, soils, atmospheric

science, agricultural economics, and rural sociology. In addition, key external collaborators include scientists at the USDA Forest Service (USFS) Northern Research Station in Columbia, MO; the Missouri Department of Conservation; the NRCS/USFS National Agroforestry Center in Lincoln, NE; the Agroecology Issue Team at Iowa State University; USDA ARS Cropping Systems and Water Quality Research, Columbia, MO; and the USDA ARS Dale Bumpers Small Farm Research Center in Booneville, AR. UMCA's research program is based on the premise that agroforestry principles, when properly applied in association with floodplains and uplands, can provide environmental and economic benefits. UMCA seeks to develop the scientific basis for designing and prescribing agroforestry practices within a "systems context" which is necessary if this technology is to be used effectively. Furthermore, if large scale adoption is to occur, practices must provide economic benefits in conjunction with conservation oriented benefits. Many landowners, while being environmentally conscious, are reluctant to change land uses unless it has a financial reward. Research is being conducted to enhance our understanding of the requirements for adoption and practices are being designed that are both environmentally sound and economically viable. The University of Missouri Center for Agroforestry is the cornerstone of agroforestry, both in Missouri and throughout the US. It is the only comprehensive, interdisciplinary research and technology transfer effort of sufficient scale and duration to provide definitive information with regard to many aspects of agroforestry (biophysical, social and economic). Dr. Norman Borlaug (Nobel prize winner) and Pedro Sanchez (World Food prize winner), both world authorities in agriculture, have identified UMCA as the leading agroforestry program in the US and perhaps in the world.

ACCOMPLISHMENTS IN AGROFORESTRY:

This report is the third in a series that dates back to January 1996. The second report was submitted in 2001.

The Missouri Economic Diversification and Afforestation Act of 1990 (commonly known as the "agroforestry bill") directed the Missouri Department of Conservation, in concert with other agencies and organizations, to develop and implement an agroforestry program. The program was to be designed to complement a new or extended federal conservation reserve program (CRP) which, as part of its provisions, allows and encourages the development of a state program of agroforestry, and encourages soil conservation and diversification of the state's agricultural base through the use of trees planted in lanes with grass strips or row crops or both in between the lanes (designated as alley

cropping). This law was amended in 2001 (House Bill No. 904) to include the University of Missouri, Center for Agroforestry as a co-operator and to expand authorization to include three other agroforestry practices - - forested-riparian buffers, silvopasture and windbreaks along with alley cropping.

Based upon 176 formal inquiries made by landowners about the agroforestry program created through the original 1990 Act, a total of 12 contracts were entered into by the MDC covering 956.9 acres. One contract was cancelled at the landowners request in 1997. Current contracts (from the original enrollment) include those in Atchison county (1 contract for 92.5 acres); Bates county (1 for 82.4 acres); Clay county (1 for 30.3 acres); Gentry county (3 for 171.9 acres); Schuyler county (1 for 12.4 acres); Vernon county (2 for 80.7 acres); and, Worth county (2 for 165.3 acres). The total acreage currently enrolled in the agroforestry program is 635.5. Many of these original enrollments have developed into quality agroforestry programs that can serve demonstration purposes. Enrollment of these programs was for 10 years - - most contracts have, or will soon, expire. These 12 contracts and 950 acres represent only a part of what has been achieved when it comes to Missouri agroforestry since the passage of the “agroforestry bill” in 1990 and its amended version in 2001.

Advancements in Missouri agroforestry during the current reporting period (2001-2006) are too numerous and comprehensive to report in a document of this nature. We will, instead, identify a few major research (production and environmental) accomplishments of special economic significance.

PRODUCTION FINDINGS OF ECONOMIC SIGNIFICANCE:

Livestock Dimensions:

With more than 13 million acres of pasture land dedicated almost entirely to beef production, and ranked number two in cow/calf production in the USA, Missouri is in a position to benefit economically and environmentally from widespread adoption of silvopasture. Through well-managed rotational grazing areas on the farm, Missouri’s agroforestry researchers are investigating the similarities and differences in cattle performance between traditional open pasture rotational grazing and silvopasture (strategically positioned trees in rotationally grazed pastures). In particular, the Center for Agroforestry is working to determine if agroforestry practices can reduce hay costs and extend the livestock grazing season through the adoption of silvopasture.

Based upon eight years of research, key findings from our silvopasture work show that:

- **Seasonal forage production is greatest from silvopasture in early spring, while the open pasture produces more forage in late spring.**
- **Approximately a 15% increase in cool-season grass growth during July and August was observed in silvopastures compared to open pasture.**
- **The microclimate effect of the trees stimulates early spring growth in silvopastures and should enable livestock producers to place cattle on silvopastures earlier in spring at a time when hay is in great demand and expensive.**
- **Silvopastures can be as productive as conventional pastures and beef producers could expect similar livestock weight gain using either system. However, because the silvopastures have the added benefit of producing wood products for future revenue, they show higher economic returns in the long term.**
- **Well-managed silvopastures can reduce winter feed costs by as much as 20%.**
- **Cows nursing calves in silvopastures lose about 10% less weight over winter, reducing the need for supplementation.**
- **Cows that give birth in silvopastures are less likely to experience calving difficulties.**

In view of the fact that Missouri is a leading beef producing state and year-round rotational pasture management is required for many landowners, our findings from silvopasture management contribute strongly to maximizing the profit margin. With total disregard to the other economic advantages of silvopasture, winter hay costs for feeding one steer can reach as high as \$91. Our research shows that through the environmental protection afforded the animal by introducing trees into a pasture; this cost can be significantly reduced leading to a greater profit for the landowner. Integrated pasture/silvopasture “systems” provide maximum opportunities for profit and improved animal health.

Our recommendation is to put policies in place to strongly encourage rotationally grazed livestock production on integrated pasture/silvopasture systems for maximum economic gain.

Forest Industry:

A study by the MDC has recently shown that the forest products industry contributed \$4.4 billion to the Missouri economy in 2005. The industry supported more than 32,000 jobs with a payroll in the range of \$1.1 billion. More than \$360 million was paid in taxes, including \$54 million in state sales

taxes. The most interesting story associated with these numbers is that they were accomplished even though our state has a very small percentage of its forested land under management. Of the 14 million acres of forested land in Missouri, most professional foresters readily concede that less than 15% is being actively managed. Applying sound forest management would easily double or triple the value of the future forest industry and give a highly significant boost to Missouri's economy. The Center for Agroforestry, in partnership with the Missouri Department of Conservation and the Missouri Forest Products Association (MFPA), is currently providing leadership for increasing the acreage of forested land under management.

Before natural forest stands can be placed under management, a market must be found for small-diameter, low grade materials that are "choking" our forests. Through the development of agroforestry forest farming technologies (thinning stands to create suitable micro-environments for growing cash crops such as mushrooms, botanicals etc.) inroads are being made. Furthermore, with planned research in the use of these low-value, wood products for production of bio-energy (cellulosic ethanol etc.), significant progress can be made in increasing our forested acreage under management resulting in new, expanded wood industries for Missouri. **The potential for growth in Missouri's forest industry rivals that of any other established industry in our state.**

The Eastern Red Cedar Industry, Poised for Growth in the Future:

Center for Agroforestry research has determined that red cedar is already a \$60 million dollar industry in the US with a rapidly expanding national market for an undervalued and abundant local natural resource. Missouri has the fourth largest eastern red cedar (*Juniperus virginiana*) resource in the US. Demand is increasing rapidly along with prices. The Center's research laid the groundwork for Missouri and surrounding states to capitalize on this heretofore undervalued and underutilized resource and is stimulating development of value-added opportunities, expanding the scope and economic impact of the industry.

Missouri's Black Walnut Industry:

The current value of the Missouri black walnut industry ranges from \$15-25 million annually. Missouri contains the only industrial scale black walnut processing facility in the United States processing between 15 and 50 million pounds of black walnuts annually. Over 99% of this harvest comes from thousands of unmanaged, wild trees scattered across Missouri and the Midwest.

Harvesters, paid 14 cents per pound for hulled, wild nuts, receive annual direct income transfer of \$1.4-7.0 million.

Hammons Products sells an average of 1.5-1.7 million pounds of nutmeats annually retailing at \$8 per pound, for a value of \$12 million dollars. In addition, walnut shell is sold for industrial use. The University of Missouri Center for Agroforestry, in partnership with the MDC and Hammon's Products of Stockton, MO has invested 12 years of research to develop the nation's only comprehensive black walnut tree improvement program. Improved black walnut cultivars, now ready for release to the growers, contain much higher nutmeat content and higher yields than the wild crop. Cultivar nuts are worth 50 to 75 cents per pound to the grower. **By 2020, an estimated 2 million pounds of plantation-grown cultivar nuts will be produced on 2,000 acres of walnut orchards in Missouri as a direct result of the research conducted by the Center for Agroforestry. The value of this new orchard production will add \$20 million dollars per year to the Missouri economy.**

Missouri's Pecan Industry:

Native pecan groves supply about 1/3 of the yield of in-shell nuts marketed in the US. The current US market for organic pecans ranges from 200,000 to 400,000 pounds (shelled) or \$1.25-2.5 million. Over 2,000 acres of native, organic pecan are in production in Missouri and eastern Kansas. Demand for certified organic pecan nut meats in Missouri far exceeds supply. UMCA research on the effects of understory crops on nutrition and pest ecology in native pecan alley cropping will increase harvest levels 25 to 100 percent with control of pecan weevil and pecan nut casebearer, critical for effective use of limited control tactics approved for use in organic pecan systems.

UMCA is the only institution working to support Missouri's growing organic native pecan industry. Growth of this industry is hampered by shortages of organic native pecan production. UMCA tree/crop interaction research will lead to increased production by increasing fertility levels and reducing losses to insect pests.

Twelve years of Center for Agroforestry funded pecan cultivar research has resulted in the identification of improved cultivars for different climatic regions of Missouri, strengthening the growth of Missouri's Pecan industry. **This will further strengthen the growth of Missouri's pecan**

industry with substantially (3-to-4 fold) higher annual yields per acre from plantation- grown cultivars over native groves.

Missouri's New Chinese Chestnut Industry:

Twelve years of Chinese chestnut research at the Horticulture and Agroforestry Research Center, located at New Franklin, MO combined with in-depth market and consumer research have Missouri at the brink of a major new industry. The Center for Agroforestry has the most comprehensive chestnut research program in the US and is in a leadership position in the US industry.

By 2020, over 1,000 acres of Chinese chestnut orchards will be producing over 2 million pounds of chestnuts with a wholesale crop value of over \$10 million to Missouri's producers.

Cultivation of Gourmet and Medicinal Mushrooms in Agroforestry:

UMCA supports one of only two research programs in the nation working to develop the premium, high-dollar European black truffle as a forest farming crop for landowners, and is finding that this gourmet mushroom can be grown in Missouri soil. Research is also being conducted to develop morel, shiitake and other gourmet mushrooms into profitable agroforestry crops.

Not only can specialty mushrooms be grown on a range of small acreage allotments, mushroom cultivation is a sustainable and profitable way to recycle low-value forestry by-products, such as small diameter (<5") trees, branches, wood chips and sawdust. As they strive for efficient, sustainable management through agroforestry, Missouri land and forest owners are developing new partnerships with natural resource agencies. The Center for Agroforestry is working to refine established production techniques for a diverse suite of outdoor mushroom species and capture a growing gourmet market.

Through international collaborations and information exchanges, and programs close to home - - including a series of guide sheets, market research and annual Specialty Mushroom Workshops - - the Center continues to accumulate a practical, scientifically-sound knowledge base for the benefit of Missouri landowners who are entering the specialty mushroom market.

Key findings from research on mushroom include:

- To meet increasingly strong market demand by wholesale produce buyers for log grown shiitake mushrooms throughout the growing season, logs can be consistently force fruited on 10 week intervals.
- Shiitake mushrooms are high-value crops, normally selling for high prices, ranging from \$5 to \$16 per pound. Highest prices are obtained when shiitake are sold at the farmers market, restaurants and online.

ENVIRONMENTAL FINDINGS OF ECONOMIC SIGNIFICANCE:

Woody Corridors Protect River Levees From Breaking:

The Missouri River flood of 1993 was of historic (500 year) proportions. Forty-eight percent of the Missouri River floodplain was damaged by either scouring or sand deposits, with deposits covering one third of the floodplain. Costs of cropland reclamation in the floodplain were expected to exceed \$500 million. By 1995, the U.S. Army Corps of Engineers had spent \$36 million for levee repairs along the river, with total repair costs to levees in the Corps levee maintenance program estimated at \$250 million. All primary levees along the Missouri River suffered damage during the flood of 1993.

Center for Agroforestry personnel investigated the relationships between levee damage and woody corridors along a 353-mile segment of the Missouri River in Missouri during the flood of 1993, and reported their findings in the Journal of the American Water Resource Association in 2003. Results indicated that woody corridors between riverbanks and primary levees played a significant role in the reduction or prevention of flood-related damage to levees. Forty-one percent of levee failures in this segment occurred in areas with no woody corridor, while 74 percent and 83 percent of failures occurred where wood corridor widths were less than 300 feet and less than 500 feet, respectively. Median failure lengths with a woody corridor present were 50.3 percent shorter than median failure lengths with no woody corridor present. Levees without failures had significantly wider median woody corridor widths than levees that failed. Eligibility for the Corps of Engineer's levee maintenance program was not a significant factor in the reduction of levee damage. **The Center for Agroforestry's findings clearly demonstrate that forestry/agroforestry practices when properly designed and correctly positioned in the flood plain landscape can significantly reduce the breeching of levees during periods of potential flooding and serve to protect valuable Missouri farmland and homes, saving the state and taxpayers tens of millions of dollars.**

Agroforestry and Grass Buffers Improve Water Quality:

During the past decade, in conjunction with a major emphasis in the U.S. Farm Bill to support conservation (e.g., CRP, EQIP), great importance has been placed on designing agroforestry-type buffers (riparian and upland) to prevent non-point source pollution (sediment, nutrients, pesticides etc.) from entering our waterways. While the research findings from the Center for Agroforestry have been remarkably significant and provide the basis for our advocating major changes in the way buffers are designed, perhaps no findings are more significant than those recently reported by one of the Center investigators.

Grass buffers were constructed to assess the effectiveness of buffer designs, species composition, and buffer length in reducing transport of herbicides (atrazine, glyphosate (Roundup), metolachlor and isoxaflutole (Balance). Native grasses, as contrasted to tall fescue, were found to be highly effective at reducing transport of herbicides. **A 13-foot buffer of native switchgrass effectively removes 75-80% of atrazine, metolachlor and glyphosate (Roundup) from runoff.** A 26-foot buffer of fescue was found to be significantly less effective in removing these same chemicals and far less effective in sediment removal - - the more narrow the buffer, the less land is taken out of production. Moreover, more sophisticated growth chamber studies designed to test the effects of several native grasses on herbicide removal clearly demonstrated that if bio-degradation of atrazine is a priority (and it should be in many areas of our state), the establishment of eastern gammagrass in a buffer configuration should be given serious consideration.

Eastern gammagrass was found to be the most effective grass in promoting bio-degradation of atrazine in the root zone. **In fact, more than 90% of atrazine was degraded in the root zone of eastern gammagrass compared to 24% in the control. Further study demonstrated that degrading bacterium found in association with the root system of eastern gamma were responsible for the degradation of atrazine and that the majority of atrazine could be transformed into carbon dioxide within 72 hours when the proper bacterium was used.** NOTE: Since these findings have not been reported yet in the literature, the specific organism that is responsible will not be revealed in this report. This finding, however, is of colossal significance to our state's agricultural community since the heavy use of atrazine in the production of corn is resulting in the contamination of ground water and wells. Additional research has shown that

Balance (an herbicide recommended for sensitive watersheds) breaks down into harmless chemicals when treated with chlorine at levels below that used in municipal water systems. The Environmental Protection Agency has hailed this finding as highly significant. **The economic value of these findings is highly significant in view of the importance of water quality to our state's tourism industry.**

Wildlife Habitat Restoration: Reforesting abandoned bottomland crop fields with oak to restore wildlife habitat:

Missouri's bottomland forests, though prone to flooding, provide excellent opportunities for wildlife habitat and diversified income through timber production when agroforestry practices are applied. In conjunction with an oak regeneration project, the Center for Agroforestry in partnership with the USFS and MDC is working to evaluate the effects of planted oak habitats on key wildlife species, including songbirds.

Songbirds are among Missouri's most conspicuous wildlife, and represent an increasingly popular recreational activity. For example, in 2001 wildlife recreationers in the US spent \$108 billion, or 1.1% of the GDP, on wildlife-related activities, and a large percentage of this was for feeding, watching, or traveling to watch birds. However, concern is mounting among scientists in recent decades about apparent population declines of many of America's most popular neotropical songbirds.

Key findings from the Center's research into the restoration of abandoned bottomland crop fields include:

- **Oak can be established in abandoned bottomland crop fields by planting large container-grown oak seedlings with a cover crop of redtop grass, producing a 98 percent survival rate after 4 years.**
- Rabbit damage, a major cause of regeneration failure, is greatly reduced in redtop fields as the wildlife habitat became more open to rabbit predators (raptors).
- Acorn production in large container seedlings of swamp white oak (derived from carefully selected mother trees) that were only 18 months to 3 years old is phenomenal compared to production in natural oak stands, which often do not produce acorn crops for 20 to 30 years. **This is a major benefit to landowners who want acorn production for wildlife purposes and it is**

important in providing a local seed source that makes possible natural regeneration of oak in the future.

- These reforested Missouri River bottomland habitats contain some of the state's most colorful songbird species, including many species of conservation concern. These habitats may also represent sources for self-sustaining songbird populations in a landscape that is increasingly fragmented by human land use.
- Where redtop grass is successfully established, invasive vegetation and weeds are almost completely controlled, and grassland songbirds have colonized abundantly. Songbirds have used the redtop plots for breeding year after year, whereas in other grasslands, many of these species would quickly drop out with increased vegetation growth.
- A startling low frequency of cowbird parasitism is recorded at these bottomland sites. Brown-headed cowbirds are a native brood parasite (they do not build nests or feed their own young but lay their eggs in other birds' nests) that has increased greatly with human alteration of the American landscape. Cowbird parasitism at Missouri River sites was less than half that at other sites in Missouri. Indigo buntings, for example, showed only a 22% rate of cowbird parasitism at Missouri River floodplain areas established to an agroforestry, alley cropping-type practice, compared to a 48% rate in Missouri oldfields - - formerly cultivated fields that have been removed from agricultural production and allowed to return to natural succession.
- Rates of nest predation by various predators, like raccoons and snakes, are comparable with rates elsewhere in Missouri; yet, because cowbird parasitism is low, nests at the bottomland sites experience higher success and lower mortality than many elsewhere in the region.
- Red-Winged Blackbirds, an abundant North American songbird often considered to be an agricultural pest, are attracted to reforested oak/redtop sites and drawn away from agricultural crops.

Management guidelines for reforesting bottomlands with high value, early mast producing oak species have been developed. As this project continues, management guidelines for songbirds in reforesting agricultural floodplains will be developed. Research results will also yield recommendations about habitat management for sensitive prairie species. The study will also be evaluated in future years to determine the effects of changing forest development upon the avian guilds and species such as turkey that require acorns for food.

Windbreaks for Odor Abatement:

Confined animal feeding operations (CAFO's) are big business in Missouri and yet, because of the offensive odors that may be associated with CAFO's, recent court decisions are making it difficult for the industry to grow. An old agroforestry technology that shows some promise to help abate this odor is windbreaks. Properly designed agroforestry windbreaks modify air movement and allow large portions of air to pass through branch and foliage structures. Research shows that the fine waxy surface on hardwood leaves and conifer needles, as well as branch surface areas, attract fine dust particles to which many odor compounds become attached. **By controlling air movement and filtering these fine dust particles, windbreaks have been shown to remove as much as 47% of the airborne ammonia coming out of exhaust fans of confined animal feeding operations.** In conjunction with other technologies, such as managed lagoons and careful land application of animal waste, windbreaks can become an effective tool to further reduce the movement of airborne odor compounds.

Recently, Center for Agroforestry personnel, working with Department of Agriculture Director, Fred Ferrell and his staff, and NRCS State Conservationist, Roger Hanson and his staff, successfully created the opportunity for producers to qualify for EQIP windbreak dollars for odor abatement. The agreement calls for a significant cost share on large seedling planting stock and drip irrigation to assure fast growth of the trees. In addition to funding provided for the initial signup period which ended November 17, 2006, an additional \$1-million was set aside for a special signup during January, 2007 to create windbreaks around animal feeding operations, farmsteads and headquarters. These windbreaks should provide some degree of protection against odor movement. With financial support from the MDA, the MU Center for Agroforestry is prepared to conduct research to evaluate the effectiveness of properly placed trees, shrubs and grasses on air and water quality near confined animal feeding operations in order to design more effective windbreaks. Throughout this process the Center's goals are to help develop technologies that benefit Missouri's agriculture while preserving our natural resources and strengthening rural communities.

AGROFORESTRY TECHNOLOGY TRANSFER:

The Economic Diversification and Afforestation Act of 1990, states that “the Director of the MDC shall develop demonstration agroforestry conservation programs to illustrate to landowners in this state the benefits and advantages of participation in such a program”. He is further instructed to contract the delivery of the demonstration and educational components of the Act to the University of Missouri Extension Service.

The demonstration and technology transfer dimensions of agroforestry in Missouri are achieved through the Technology Transfer Program within the University’s Center for Agroforestry. This is in part supported by an MDC annual grant of \$35 thousand which provides partial funding for a full-time technology transfer specialist and full funding to publish 4 issues of a newsletter “Green Horizons” which has a circulation of 4,000. Green Horizons serves to keep practicing agroforesters apprised of new agroforestry opportunities and practicing foresters up-to-date on market trends and state-of-the-art forest management techniques.

A primary goal of the Center for Agroforestry is to educate and inform landowners and natural resource professionals about new research in agroforestry, and to demonstrate how this can be applied successfully to their operations. The UMCA Technology Transfer team works side-by-side with landowners, resource professionals and extension agents from across the state, and the Midwest, through on-site consultations, educational guides and workshops and informational exhibits. These outreach activities are introducing the benefits of agroforestry practices, and the products made through these practices, to land and forest owners, natural resource professionals and consumers.

As was the case with agroforestry research accomplishments during the past 5 years, accomplishments in agroforestry technology transfer are too numerous to identify. For the purpose of this report, we will provide a review of the accomplishments during 2005 which represents a typical year.

During 2005, the UMCA Technology Transfer team participated in more than 30 agricultural and natural-resource related conferences and events, serving as featured speakers at many of these events. From the National Small Farms Trade Show to the Chestnut Growers of America convention, the Missouri State Fair and the Tri-State Forest Stewardship Conference, the team reached thousands of

land and forest owners with new research findings and information on the benefits of forest management and agroforestry.

Revised Agroforestry Training Manual:

A newly revised and updated Training Manual for Applied Agroforestry Practices was completed in December 2005. This manual represents the state-of-the-art in agroforestry, incorporating the latest agroforestry research findings with landowner success stories and a real world case study. In addition to expanded chapters on all five recognized agroforestry practices, the manual contains updated and/or new sections on planning, wildlife, marketing and economics. A workbook for agroforestry planning was created to help landowners put their ideas into practice.

Riparian Forest Buffer Field Day:

The maintenance of existing forests in areas adjacent to streams, and the establishment of productive trees, shrubs and grasses in these flood-prone areas, is one of the Center's major research areas. To extend current research knowledge about buffer function and market opportunities through riparian forest buffers, the Center for Agroforestry and its research partners – including the Missouri Department of Agriculture Forest Land Enhancement Program – hosted a field day focusing on buffers and their application on the land. Topics included planting configurations on the landscape, species selection for riparian buffers, buffer function and design, value-added opportunities, wildlife management and financial considerations.

Shiitake Mushroom Production:

Specialty and gourmet mushroom production, including shiitake mushrooms, is a promising component of the Center's forest farming research dimension. In April 2005, the Technology Transfer team collaborated with Ozark Forest Mushrooms (a successful retail mushroom business located in southern Missouri) with funding from the Sustainable Agriculture Research and Education Program (SARE) to host a hands-on workshop, featuring demonstrations of shiitake mushroom production and profitable forest management through agroforestry practices. Participants learned step-by-step about the shiitake mushroom process, from the management of the forest for mushroom log production to packaging and marketing fresh and dried shiitakes for retail sales.

UMCA Co-Sponsors Agroforestry Grants for Landowner Demonstrations:

The Center has demonstrated its commitment to assisting landowners with the establishment of agroforestry practices by partnering with the Missouri Department of Agriculture's (MDA) Sustainable Agriculture Demonstration Awards program (no longer supported by MDA). In 2005, UMCA sponsored three grants to focus on sustainable projects that involve agroforestry.

Agroforestry Center Sponsored Professional Trainings:

As part of an ongoing commitment to increase the knowledge and adoption of agroforestry practices across Missouri and the Midwest, the University of Missouri Center for Agroforestry has expanded the depth and reach of its training program. This effort began with a successful Agroforestry Professional Training Workshop held January 10 and 11, 2006, in Columbia, MO. In the fall of 2005, the Center was awarded a Sustainable Agriculture Research and Education (SARE) Professional Development Program (PDP) grant to fund a series of agroforestry trainings geared toward a targeted audience: individuals from state and federal government agencies, University Extension personnel, and non-profit and professional organizations dealing with issues that directly impact landowners and their management of forests and farms. More than 50 professionals representing several disciplines in the natural resource-based fields attended the January training. The training was designed to increase core agencies' knowledge about agroforestry practices and the benefits they offer when applied as sustainable farming practices, and to foster the establishment of social networks for assisting resource professionals and landowners in finding answers regarding the establishment and management of agroforestry.

Annual Missouri Chestnut Roast:

The Technology Transfer team and Horticulture and Agroforestry Research Center (HARC) staff host educational events and tours regularly, including the annual Missouri Chestnut Roast. The family-oriented event draws a crowd of more than 4,000 guests each fall to showcase the benefits of agroforestry – including the production of value-added products like chestnut, pine straw and decorative woody florals – at the HARC farm in New Franklin, MO.

From radio program coverage on chestnuts and mushroom production, reaching more than 35,000 listeners, to nation-wide Associated Press news coverage and specialized tours, the Center for Agroforestry continues striving to make “agroforestry” a household name. Media appearances and

special events are tailored to the specific audience, from the health benefits of nut consumption to the market possibilities for value-added niche products produced through agroforestry practices.

SUMMARY

An emphasis on the research and educational dimensions of agroforestry in Missouri is of recent origin dating to approximately 1996. Because of this, and the limited acreage currently in agroforestry, it is somewhat difficult to project agroforestry's ultimate potential. However, we know that interest is high and are confident that the agroforestry technology being developed and extended to Missouri landowners will increasingly be adopted and result in a significant boost to Missouri's economy. Agroforestry, as a form of agriculture, is more than just the sum of its parts – trees, crops and livestock. **Through proper design and application, agroforestry practices can achieve increased productivity and profit while also enhancing resource stewardship and land conservation.**

RECOMMENDATIONS:

- Develop state legislation that is designed in such a way that it provides a substantial (up to 75%) cost-share to Missouri landowners who wish to establish agroforestry practices for both conservation and entrepreneurial benefits. It is believed that conservation practices that add economic and environmental benefits to the landowner's balance sheet are more likely to be sustained in the long-run.
- Strengthen the co-operation between the University of Missouri's agroforestry technology transfer program and the MDC's landowner assistance program in delivering agroforestry technology to the user.
- Increase the co-operation between the MDC and the University of Missouri, Center for Agroforestry in providing in-service, agroforestry training for agency personnel.
- Create funding, other than from the MDC's budget, which will support new signups for the Economic Diversification and Afforestation Act of 1990 as amended in 2001.
- Strengthen current UMCA efforts to launch new black walnut and chestnut industries throughout Missouri by providing 3 years of financial support for a full-time UMCA nut tree horticulturist
- Strengthen current UMCA efforts to support the development of rotationally grazed livestock production under conditions of trees being introduced into pastures for maximum economic gain by providing 3 years of financial support for a full-time UMCA silvopasture scientist.